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Johne's Disease (Paratuberculosis) of Cattle¹

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NATURE OF THE DISEASE, ITS DISTRIBUTION AND IMPORTANCE

Johne's disease (paratuberculosis) is a chronic infectious disease of cattle and occasionally of sheep and goats, characterized by inflammation of the intestines and a recurrent diarrhea that may persist for months. A gradual loss of flesh results even though the appetite may remain good. The disease was first reported in Germany—in 1895—by Johne and Frothingham as a form of tuberculosis. However, Bang, in Denmark, determined that it was caused by a specific organism and suggested the name "paratuberculosis." It has since been diagnosed in many parts of the world and in some livestock-producing countries is causing serious economic losses.

The disease was diagnosed for the first time in the United States in 1908, and since then it has been reported in almost every State. The shaded areas on the map (fig. 1) represent counties in which Johne's disease has been diagnosed in one or more herds of cattle. This information has been gathered over a period of years and shows where the malady either exists or has existed. Probably additional infected counties would be found if more testing were done and the disease reported each time it was diagnosed.

¹ This circular supersedes Circular No. 104, Johne's Disease (Paratuberculosis) of Livestock, by Elmer Lash (retired) and William Mohler.

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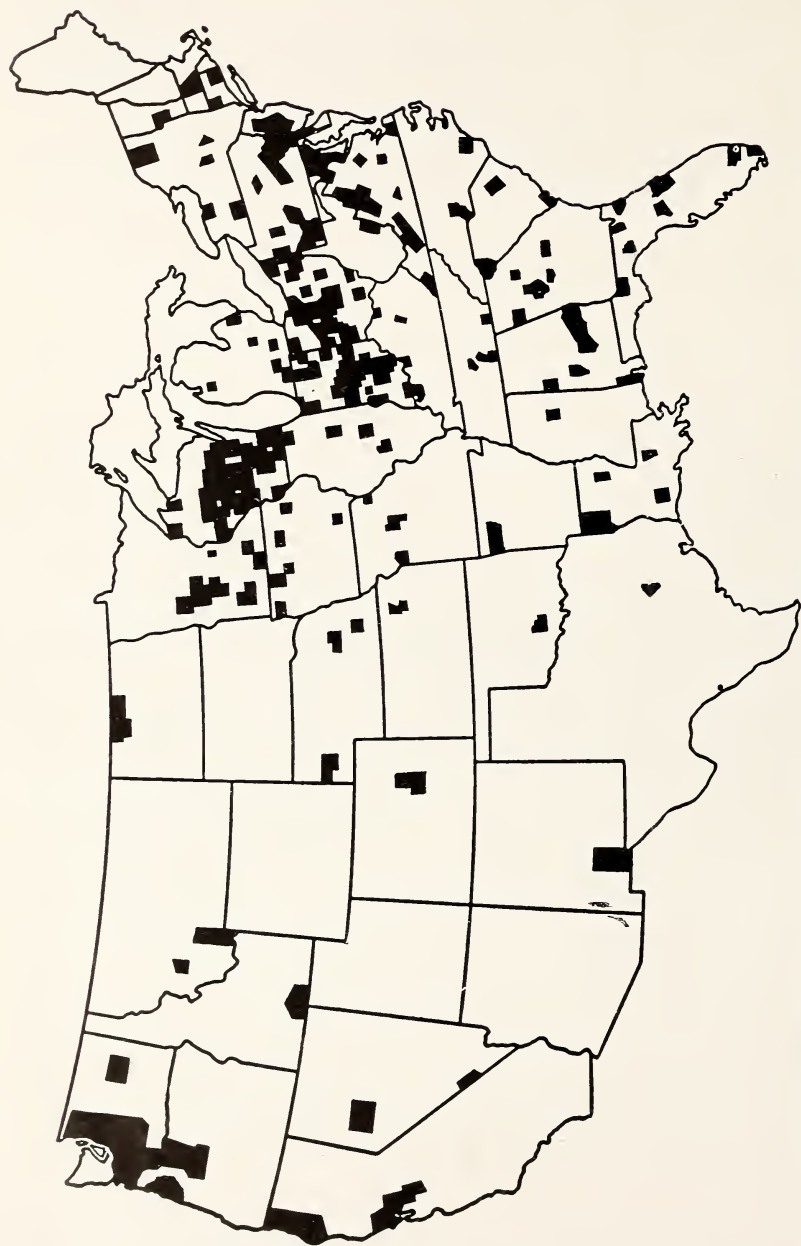


FIGURE 1.—Distribution of Johne's disease in the United States. Shaded areas represent counties in which the disease has been diagnosed in one or more herds of cattle.

The annual death loss in infected herds may be as high as 10 percent of the adult animals. However, in most instances the annual loss does not exceed 3 percent. Little effort has been made to control the disease in herds where the losses are not great. Unfortunately, some of these are purebred herds from which animals are sold for breeding purposes, thus gradually spreading the disease to other herds. Johne's disease may become very prevalent and troublesome in the United States unless more attention is given to its diagnosis and control.

SYMPTOMS

Symptoms usually appear in animals 2 to 6 years of age, often shortly after parturition. Usually the first noticeable evidence is chronic intermittent diarrhea without straining, although a gradual loss of weight may precede scouring by several months. The animals develop an unthrifty appearance, the hair coat being rough and the skin dry. The appetite is good, the temperature and pulse normal. If the infected animals are producing milk the yield may decrease before clinical symptoms are observed; it ceases entirely when symptoms appear. Infected animals continue to scour and waste away until they become extremely thin; most such animals die.

Figure 2, *A*, shows a 29-month-old heifer of mixed breeding that was a reactor to the intradermic johnin test, although no symptoms of the disease could be observed at that time. Figure 2, *B*, shows the same animal 11 months later—90 days after the first clinical symptoms were noted. She had lost 180 pounds in weight since first evidence of the disease and was destroyed as incurable shortly after this picture was made. Occasionally an animal with symptoms may show temporary improvement and gain weight for a variable period of time. Such an animal usually begins to scour again after several weeks or months. Recovery seldom takes place in an animal in which clinical symptoms have been observed. Johne's disease spreads slowly in a herd. In one of average size usually not more than one or two animals show symptoms at any one time. Such losses may continue at this rate for several years before the owner suspects that he has a contagious disease in his herd.

CAUSE OF THE DISEASE

The cause of Johne's disease is a small rod-shaped acid-fast bacillus named *Mycobacterium paratuberculosis*. This organism has staining characteristics identical with those of the tubercle bacillus. Close resemblance makes positive differentiation under the microscope difficult or impossible. The bacteria attack the intestinal lining, where they are usually found in clumps. They are most often found in the posterior part of the small intestine, ileocecal valve, the large intestine, and the rectum, although they may also be found in the adjacent mesenteric lymph glands. Ruminants are the only animals that have been found to be susceptible to infection.

M. paratuberculosis bacilli are very difficult to culture on artificial media. Small pieces of infected tissues are usually submerged in 10 to 15 percent of antiformin or 5 percent of oxalic or sulfuric acid for about 30 minutes in order to destroy all except acid-fast bacteria. The

treated pieces of tissue are then placed on sterile media containing dead acid-fast bacilli, macerated bovine mesenteric lymph glands, and other nutrients. The cultures are incubated at 37.5° C. Evidence of growth in the form of small whitish colonies may appear 6 to 12 weeks after inoculation. Since other acid-fast bacilli may survive



FIGURE 2.—A, A reactor to the johnin test, although showing no clinical symptoms of the disease; B, the same animal 11 months later—90 days after the first clinical symptoms were noted.

the antiformin or acid treatment, the colonies should be identified by bacteriological and immunological tests.

Large numbers of bacilli may be passed in the droppings of infected animals. It is generally believed that droppings are the principal source of infection. Susceptible animals are infected orally by coming in contact with the droppings. Calves are more easily infected in this manner than are older animals. The incubation period may range from several months to several years. In controlled experiments conducted by Bureau investigators the shortest incubation period was 13 months.

DIAGNOSIS

Johne's disease is sometimes difficult to diagnose. Parasitism and malnutrition may confuse the clinical diagnosis, as these conditions may be mistaken for Johne's disease or exist simultaneously with it. Heavily parasitized animals are usually younger than animals showing evidence of Johne's disease; furthermore, eggs or oocysts of the parasites will be found in large numbers in their droppings. Malnutrition is remedied by proper feeding. A well-fed mature animal showing an intermittent diarrhea accompanied by a gradual loss of weight should be suspected of having Johne's disease, especially if it does not respond to treatment.

THE JOHNIN TEST

Since many infected animals may not show symptoms until they have transmitted the disease to other animals in the owner's herd, a diagnostic test is valuable in detecting diseased animals in herds suspected of having Johne's disease. Before the development of the method used by the United States Bureau of Animal Industry, Bang in 1909 reported testing cattle with avian tuberculin administered subcutaneously. He found that many of the infected animals reacted to this test. Later, when *M. paratuberculosis* had been isolated and cultivated on liquid media a testing agent—johnin—was prepared from it.

Johnin is prepared from *M. paratuberculosis* bacilli in the same manner as tuberculin is prepared from *M. tuberculosis* bacilli. The bacilli are inoculated on a liquid medium and incubated at 37.5° C. until satisfactory growth has been obtained. The bacilli are then killed by steam sterilization and discarded by filtering. The medium is concentrated, refiltered, and tested for sterility and potency to obtain the finished product. Johnin has the same physical appearance as tuberculin, but it requires a longer time to prepare because *M. paratuberculosis* grows more slowly in liquid medium than does *M. tuberculosis*.

Johnin did not come into general use until bacteriological methods and media had been developed to cultivate *M. paratuberculosis* successfully. Both johnin and avian tuberculin have been used subcutaneously, intravenously, and intradermically to detect Johne's disease in ruminants. The subcutaneous test is seldom used in this country, and the intravenous test is used only to a limited extent. In

these two tests, the animals are closely observed and their temperatures are recorded at regular intervals. An elevation of temperature within 12 hours, chills, and a diminished milk yield following injections, indicate a positive reaction.

The intradermic test with the use of 0.2 cc. of johnin is commonly employed by the United States Bureau of Animal Industry in herds suspected of having Johne's disease. This test is less time consuming and is as accurate as the other methods. It is similar to the intradermic tuberculin test except that johnin is used instead of tuberculin. Injections of johnin into the skin of the caudal fold or the cervical (neck) region of infected cattle will produce local reactions comparable to those seen in tuberculous cattle following the intradermic injection of tuberculin.

CONFIRMATION OF CLINICAL DIAGNOSIS

To confirm the clinical diagnosis in a living animal showing symptoms, it is necessary to obtain positive results from the johnin test and to find the bacilli in stained smears obtained from a rectal scraping. At the Regional Animal Disease Research Laboratory at Auburn, Ala., smears from this material obtained from living animals showing symptoms have contained *M. paratuberculosis* organisms in 50 percent of the examinations. Even if the bacilli are not found the animal should be isolated. If it is killed a post-mortem examination should be conducted. The examiner should remove and open a portion of the large intestine about 24 inches long containing the ileocecal valve and about 12 to 18 inches of the attached small intestine because the bacilli are more numerous in this area. The contents should be discarded and the mucosa rinsed lightly with water. Any other portions of the intestines showing inflamed areas, as well as all adjacent mesenteric lymph glands, are also likely to contain *M. paratuberculosis* bacilli and should be collected. This material may then be forwarded to a diagnostic laboratory for bacteriological examination.

Before shipment the specimen must be covered with a thick layer of powdered borax, wrapped in clean gauze or muslin, and placed in a water-proof container. If the specimen is to be taken directly to a laboratory it may be packed in ice instead of borax. The specimen should be accompanied by a letter giving full information on species, age, history, symptoms, and other disease conditions and parasites of the animal from which the specimen was taken. Most specimens taken from animals with symptoms of Johne's disease show *M. paratuberculosis* bacilli on microscopic examination. However, negative findings do not necessarily indicate that the disease is not present.

POST-MORTEM FINDINGS

The carcass is emaciated and little fat is present. Lesions are confined to the intestinal tract and adjacent lymph glands. The mucosa of the lower portion of the small intestine and of parts of the large intestine is usually several times thicker than normal (fig. 3). This thickening causes irregular coarse folds, which do not disappear when the intestine is stretched tightly. The folds are especially prominent in the region of the ileocecal valve, the walls of which are often several

times as thick as those of a normal valve. Patchy corrugations are sometimes found at intervals along both the small and large intestines. Although the mucosa is greatly thickened and inflamed, eroded areas or ulcers are not found. Occasionally an animal with marked clinical symptoms shows no macroscopic changes in the intestines, but acid-fast bacilli are usually found in smears made from such an intestine.



FIGURE 3.—Intestinal mucosa from an animal infected with Johne's disease. Note the deep folds, which cannot be removed by stretching the intestine.

CONTROL AND ELIMINATION

No satisfactory method has been found for treating animals affected with Johne's disease. Various drugs have been investigated but none has proved to be a definite cure.

Although still in the experimental stage, johnin injected intradermically has considerable value as a diagnostic agent, when properly used. If the number of reactors to the test is not large they, as well as all animals showing clinical symptoms, should be removed at once and slaughtered. However, if the number of reactors is large, disposing of all of them may be too heavy a loss to the owner. He therefore may decide to take immediate steps to eliminate only those animals showing clinical symptoms of the disease, and to dispose of the remaining reactors by slaughter as rapidly as young animals can be raised for replacement. This procedure, however, involves a risk as reacting animals may spread the disease even though they show no symptoms. No breeding stock should be sold as long as reacting animals remain in the herd.

Immediately after the removal of infected animals the premises should be disinfected in a manner approved by the United States Bureau of Animal Industry for tuberculosis eradication. This in-

cludes the use of approved disinfectant on all mangers, pens, troughs, walls, and floors.

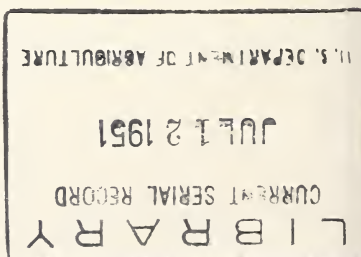
Young calves in dairy herds in which reactors exist or have recently existed should be removed from their dams during the first 24 hours of life and reared to maturity in separate quarters that have not been used by infected animals. Feed and water containers must be protected from cattle droppings. Stagnant water holes should be fenced off or drained. All lots used by infected animals should have all manure and 4 inches of top soil removed. Any animal showing signs of ill health must be immediately isolated until the cause has been determined. If a diagnosis of Johne's disease is made, the animal should be slaughtered at once. Periodic intradermic johnin tests should be conducted on the entire herd. If negative results are obtained from three successive tests at 6-month intervals and no clinical symptoms have been observed, the herd is probably free of the disease. Unless all recommendations are followed the disease will not be eliminated.

Livestock owners should take every precaution to keep their herds free from Johne's disease because of the difficulty and expense of elimination once it is established in a herd. Any animal purchased from a diseased herd is a potential source of infection, even though it may give negative results to the test at the time of the purchase, since an animal may not always react during the long incubation period.

INDEMNITY FOR JOHNIN REACTORS

The United States Bureau of Animal Industry has been granted authority by Congress to pay indemnity to owners for cattle that are slaughtered because of reaction to the johnin test. These payments are made on the same basis as that on which indemnity is paid on tuberculous cattle.

Indemnity funds have been available for this purpose since July 1, 1927, from which a number of livestock owners have received benefits. Further details concerning the payment of indemnity on cattle reacting to Johne's disease can be obtained by writing the livestock officials of your State or the Bureau of Animal Industry of the United States Department of Agriculture, Washington 25, D. C.



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